THE RELATION BETWEEN THE ECONOMIC DEPTH OF A BRIDGE TRUSS AND THE DEPTH THAT GIVES GREATEST STIFFNESS.

BY MANSFIELD MERRIMAN.

(*Read April 14, 1905.*)

The fact that there is a certain depth for a bridge truss which renders the quantity of material a minimum has long been known, and the marked increase in the depth of bridge trusses which has occurred during the past quarter of a century is due to the efforts of manufacturers to use the least possible amount of material. It has generally been supposed that the vertical deflection of a bridge under a moving load decreases with the depth, and this is true for plate girders. For a truss, however, investigations made by the author show that the least deflection and hence the greatest stiffness increases up to a certain limit, as the depth increases, and then decreases, so that there is a depth which gives the truss its greatest vertical stiffness.

The following are the results obtained by the author for the type known as the deck Pratt truss. Let l be the span, d the depth, p the panel length, and n the number of panels, so that $l = np$. The economic depth was obtained by forming an algebraic expression for the amount of material in the truss in terms of its dimensions, given loads and allowable unit-stresses, and then finding the value of d/p which renders that expression a minimum. There were found,

for n =	4	8	12	20	30
d/p =	1.29	1.73	2.08	2.65	3.21
d/l =	0.32	0.22	0.17	0.13	0.11

which shows that d/p increases with length of span while d/l decreases with length of span. To determine the depth that gives greatest stiffness, an algebraic expression for the stored energy in the truss due to the deformation of its members was formed and this equated to the deflection due to the given loads. Then the values of d/p that render this expression a minimum were deduced for different values of n, as follows:

for n	=	4	8	12	20	30
d/p	=	1.29	1.63	1.92	2.38	2.85
d/l	=	0.32	0.20	0.16	0.12	0.09

which give laws similar to those of the economic depth, and which show that the depth which gives the greatest stiffness is slightly less than the economic depth. It hence appears that no additional stiffness can be imparted to a bridge by giving to the truss a depth greater than the economic depth.

April, 1905.